should be read, a multiplied by b, the symbol $a.b$ or ab should mean a multiplied into b, so that $a \times b$ and $b.a$ or ab are identical. Perhaps a compromise might be effected on this basis in the notation of quaternion multiplication.

The "unnamed French mathematician" who is quoted in the notice in question as asserting that quaternions have no sense in them, is stated by M. Laisant to have been M. Prouhet, and to have expressed this opinion in the *Nouvelles Annales de Mathématique* (1863, p. 333), in reviewing the first work published in French on quaternions, the author of which was M. Allégret. W. STEADMAN ALDIS.

Auckland, New Zealand, February 20.

Mr. Crookes and the Transformation of Heat-Radiations into Matter.

PROF. CLIFFORD, in the *Fortnightly Review*, June 1875, wrote as follows:—"But if the ether did absorb light, what would this mean? Vibratory motion of solids, which is really a molecular disturbance, is absorbed by being transformed into other kinds of molecular motion, and so may finally be transformed to the ether. There is no reason why the vibratory motion of the ether should not be transformed into other kinds of ethereal motion; in fact, there is no reason why it should not go to the making of atoms" ("Lectures and Essays," by W. K. Clifford, vol. i. p. 246).

Mr. Crookes, in his Presidential Address to the Chemical Society, March 28, brought forward a somewhat similar hypothesis, for he says:—"If we may hazard any conjecture as to the source of energy embodied in a chemical atom, we may, I think, premise that the heat-radiations, propagated outwards through the ether from the ponderable matter of the universe, by some process of Nature not yet known to us, are transformed *at the confines of the universe* into the primary—the essential—motions of chemical atoms, which, the instant they are formed, gravitate inwards, and thus restore to the universe the energy which otherwise would be lost to it through radiant heat."

The hypotheses will be seen to be exactly alike, except for the speculation introduced by Mr. Crookes of the transformation taking place "at the confines of the universe." What do we know of the confines of the universe? Nothing. Are we *now* to begin building up hypotheses on such foundations—foundations concerning which we know nothing, and are not likely to know anything *for some time*? HUGH GORDON.

Royal Institution, March 31.

Green Colouring-matter of Decaying Wood.

MR. IRVING writes (p. 511): "After an examination of thin sections" of the decaying wood "with the microscope, I am unable to trace this to any saprophytic organism."

I have at the present time a coccus, I suppose, growing on the surface of nutrient gelatin, which is stained a beautiful green, highly fluorescent, by the colouring-matter absorbed by it from the micro-organisms. The cultivation is in a test-tube of nutrient gelatin inoculated by scratching the surface of the gelatin with a needle which had been rubbed on a colony, isolated by plate-cultivation, and obtained from a bad water.

The growth, a greenish-white, is entirely on the surface—so entirely that the scratches made in inoculating the gelatin are still visible, three weeks after the inoculation, and the gelatin is perfectly transparent.

Under these circumstances it is quite certain if I made sections of the green gelatin no micro-organisms would be found in them.

It may be that the decaying wood is stained in the same way by colouring-matter absorbed by the sap or the moisture of the wood by micro-organisms growing on its surface.

It is a fact, I believe, that the colouring-matter formed by chromo-genic micro-organisms does not reside in their structures but in the interspaces between them, so it would naturally be absorbed by any solvent they were in contact with, while the organisms themselves might remain entirely on the surface, as they do in the case of my gelatin.

This may explain why Mr. Irving has failed to find micro-organisms in the sections he made. Further, if the colour of his green wood is caused by the same micro-organism which stains my gelatin green, it is a very small one, so small that, with a 1/15-inch oil-immersion object-glass, and a No. 12 compensating eye-piece of Zeiss, I find it very difficult to decide what shape it is, but I think it is not spherical.

I think Mr. Irving will find references to the literature of chromo-genic micro-organisms in Crookshank's "Manual of Bacteriology." HENRY ROBINSON.

The University Chemical Laboratory, Cambridge.

Comet *a* 1888 (Sawerthal).

I SAW comet Sawerthal to-day at 3.40 a.m., with power 20 on a 4¼-inch refractor. It was about 50′ immediately below θ Pegasi, and had a bright broad tail, which I could only distinguish to a length of 65′, on account of the twilight, moonlight, and the comet's low altitude. I thought the tail was slightly curved, concave to south; it pointed on the average to a little above ν Pegasi, or at a position-angle of about 260°. The total light of the head was considerably fainter than θ Pegasi, and considerably brighter than ν, so that it would be from 4 to 4½ mag.; but owing to the unfavourable conditions I could not see it with the naked eye. T. W. BACKHOUSE.

Sunderland, April 3.

THE HITTITES, WITH SPECIAL REFERENCE TO VERY RECENT DISCOVERIES.[1]

II.

THE monuments at Boghaz-Keui and Eyuk are on the east of the River Halys; and it seems doubtful whether there is evidence that the country inhabited by the Hittites extended much, if at all, beyond a line drawn from Sinope on the Euxine to the most westerly bend of the Halys, and continued through the peninsula to the Mediterranean. No doubt sculptures with Hittite characteristics have been found further to the west, as at Giaour-kalessi, in Phrygia, and at Karabel, near to Smyrna and to the coast of the Ægean; but as yet it does not appear certain that these sculptures denote permanent occupation, or that they are more than monuments of successful military expeditions. The Euphrates may be taken as marking vaguely the eastern boundary of the Hittite land. To the south, in Syria, the Hittite country certainly extended as far as Kadesh, a site on or near the present Lake of Homs.

It is with the inscriptions and the engraved seals found in, or connected with, the district I have indicated that Hittite researches are mainly concerned. The few characters on the monument at Karabel are too far obliterated to be, for the present, of much importance. In 1812, Burckhardt visited Hamah, the ancient Hamath, in Syria. He saw in the corner of a house in the bazaar "a stone with a number of small figures and signs, which appear to be a kind of hieroglyphical writing, though it does not resemble that of Egypt" ("Travels in Syria," Lond., 1822, p. 147). But, as Dr. Wright remarks, "so little interest was taken in his discovery, even by professional explorers, that Porter, in Murray's 'Hand-book,' so late as 1868, declares 'there are no antiquities in Hamah'" ("Empire of the Hittites," 2nd ed., p. 1). There were, however, other inscriptions at Hamah besides that noticed by Burckhardt, and the stone bearing one of these was supposed to possess mysterious properties, efficacious for the cure of spinal disease, so that "deformed persons were willing to pay for the privilege of lying upon it, in the hope of a speedy cure" (Burton and Drake, "Unexplored Syria"). After sixty years, or nearly so, from the time of Burckhardt's discovery, attention was called to the Hamath inscriptions, first by Mr. J. A. Johnson, United States Consul at Beyrout, and subsequently (1872) by Capt. R. F. Burton and the late C. F. Tyrwhitt Drake, in the work just quoted. In 1872, however, Dr. Wright was successful in obtaining casts of the Hamath inscriptions, while the originals were transmitted in safe custody to Constantinople. The arrival of Dr. Wright's casts in this country was naturally followed by attempts at the decipherment of the hieroglyphics, though some of those who made these attempts had previously concerned themselves with the imperfect representations given by Burton and Drake in the work already mentioned. About the same time (1872) attention was called to the inscription then existing at Aleppo, but since unfortunately destroyed. Not very long afterwards an interesting bas-relief at Ibreez, in Lycaonia, accompanied by an inscription, was brought anew under notice by the Rev. E. J. Davis; and in 1876 Prof. Sayce observed with reference to this inscription, "The Hamathite hieroglyphics appear to have been an invention of an early population of Northern Syrians. Their occurrence in Lycaonia is probably due to Syrian conquest." Still later, and in view of the sculptures of Boghaz-Keui and Karabel, together with other monuments, Prof. Sayce took a much wider view, extending Hittite presence and influence through Asia Minor. Not long after taking this more extended view of the Hittites, the same scholar made a discovery of no small importance with regard to the decipherment of the inscriptions: I allude to the discovery that certain characters on the seal of Tarkutimme were Hittite hieroglyphics (*Academy*, August 21, 1880). The true nature of these hieroglyphics had not been previously seen, though, together with the cuneiform inscription round the circumference, they had been discussed by the late Dr. Mordtmann.

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[1] Based on Lectures delivered by Mr. Thomas Tyler at the British Museum in January 1888. Continued from p. 514.

The history of this now celebrated seal is certainly remarkable. About the year 1860, a convex silver plate bearing the inscriptions just alluded to was presented for sale at the British Museum. Doubt was entertained concerning the genuineness of this silver plate as an antiquity, and the purchase was declined, though an electrotype copy was made and preserved. On account of the prolonged interval which has elapsed, the precise ground of doubt is not now altogether clear. It seems not unlikely, however, that the decision as to the spuriousness of the plate was arrived at after several considerations had been duly weighed. The silver of the plate may have seemed too well preserved for an object of so great antiquity, unless, indeed, it had been in some special manner sealed up and protected in a vase or other receptacle. Then the character of the engraving was probably regarded as inconsistent with the idea of its having been cut originally in silver, and especially in a comparatively thin silver plate, the engraving being rather that of stone, on which material, indeed, a seal was much more likely to be engraved. And another important fact, as agreeing with this view, is a flaw which appears on the right hand of the central figure, and which suggests the fracture or chipping of stone rather than the abrasion of metal. On these grounds, probably, the conclusion was arrived at that the plate was not a genuine antiquity.[1] Most likely it was a cast or electrotype from an ancient stone seal, this seal having been retained by the discoverer—whoever he may have been—with the view of obtaining eventually a larger profit by its sale. Proceedings of this kind are not unknown at the Museum. But where the original seal then was, or now is, has never been known; and the silver plate offered at the Museum has likewise disappeared from view. But this disappearance is of little importance to science, if the genuineness of the inscriptions can be fully proved.

In favour of this genuineness it must be urged as improbable that any from among the few Assyriologists who were to be found in Europe nearly thirty years ago would have co-operated in forging the seal. Moreover, there are two difficulties in the way of believing in such a forgery. First, the cuneiform legend has peculiarities which distinguish it from any other known type of cuneiform writing, as was observed by Dr. Mordtmann. Then there is an interspace over the head of the standing figure, which might seem, at first sight, to be interposed between the beginning and end of the cuneiform legend. It occurs, however, in the middle of a word. For this interspace a possible reason may be derived from the recently-discovered Yuzgât seal; but its occurrence does not suggest the idea of forgery by a scholar conversant with the cuneiform characters. Supposing, however, that these difficulties are put aside, there remains the much stronger argument furnished by the characters in the central space, which are certainly Hittite. Now, and for some time past, great interest has been displayed in relation to Hittite inscriptions; but in and about the year 1860 the case was far otherwise. There was then no temptation to forge these Hittite inscriptions on the seal, even if it had been possible to do so. But it may be doubted whether at the time in question it would have been possible to find and bring together the various Hittite characters. Besides, it is not difficult to discern a concinnity and agreement between the cuneiform and Hittite adverse to the idea of forgery, and consistent only with the opinion that the seal is, with its inscriptions, a veritable bilingual.

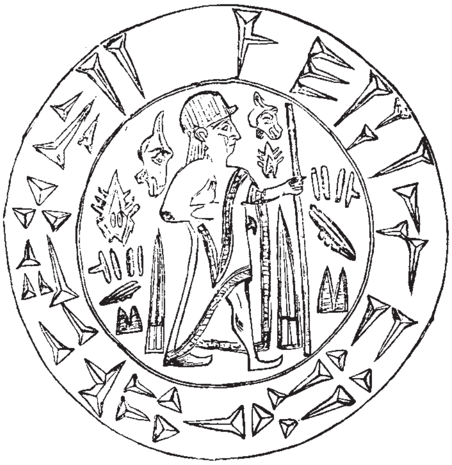

FIG. D.—Bilingual seal of Tarkutimme (enlarged).

About the time already mentioned (1860), Dr. Mordtmann examined at Constantinople a convex silver plate, then in the possession of M. Jovanoff, probably the identical plate which was offered at the British Museum. Concerning this plate, Dr. Mordtmann wrote, with date "Constantinople, December 6, 1861," a contribution to Grote's "Münzstudien," entitled "Sceau de Tarkoumdimmi, roi de Tarsous"; the designation "Tarkoumdimmi, roi de Tarsous," being Dr. Mordtmann's reading at that time of the cuneiform inscription on the seal. He noticed also, very appropriately, the resemblance of the name on the seal to the names Tarcondimotus, *Ταρκονδίμοτος*, as found in Tacitus, Strabo, and Dio Cassius, names employed to denote a father and son, Cilician kings who reigned in the time of Augustus. Dr. Mordtmann mentioned, also, that Plutarch gives, instead of the longer form, the shorter name *Ταρκόνδημος*, a name approaching still closer to that on the seal, expressing, however, at the same time the opinion that the king to whom the seal belonged was of much earlier date.[1] As to the name of the place mentioned, Dr.

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[1] The decision arrived at was probably in accordance with the view of Mr. Ready, who then was, as he still is, at the Museum. What has been said as to the style of engraving and the fracture was, most likely, suggested by him at the time, though he cannot now recollect the details of the matter.

[1] Prof. Sayce has called the seal "The Boss of Tarkondemos." But I do not see how in any way the seal can be suitably designated a "boss." And, even if it be conceded as certain that "Tarcondemos" represents the name given on the seal, still it is a Græcized form which cannot be used with propriety to denote a king who, according to Prof. Sayce's view, probably lived some 700 years B.C.

Mordtmann seems to have been first inclined to give *Zousous*, but, as no other authority for such a name could be found, he changed this conjecturally for *Tarsus*.

The Hittite characters Dr. Mordtmann regarded as, on the whole, emblems of the country, with its productions, over which the king ruled, and not as forming inscriptions, or an inscription. He made, however, some important observations with regard to the relation of these characters, as well as the figure and equipment of the king, with what was to be seen on other monuments. The boots with turned-up toes were found also at Boghaz-Keui, Eyuk, and Eregli, in Cappadocia ("Les Monuments d'Uyuk, de Bogaz-keuy, et d'Éregli, en Cappodoce"), as well as on the monument at Karabel, near Smyrna. The dagger was to be seen at Boghaz-Keui, and the spear at Karabel. The figure at Karabel, also, was without a beard, like that on the seal. At Karabel, too, were the same characters found between the head and the spear.[1] The accoutrements of the king were like those of the Cilician soldiers in the army of Xerxes, as described by Herodotus (lib. vii. ch. 91).

About ten or eleven years later, Dr. Mordtmann returned to the seal, and discussed it in the Journal of the German Oriental Society (*Zeitschr. d. deutsch. morgenländ. Gesellsch.*, vol. xxvi. p. 625). He then gave, as the name of the king, "Tarkudimme," and, though regarding the name of the place, "Tarsun," as tolerably well ascertained ("ziemlich gesichert"), yet he would not make, he says, any strong opposition if it should be preferred to substitute *zu* for the *tar*, forming the first syllable of this name. With regard to the Hittite characters, this article does not mark any very conspicuous advance, except that the animals' heads, which Dr. Mordtmann had previously regarded as the heads of horses, he now more accurately described as the heads of goats "Ziegenköpfe").

Though Dr. Mordtmann anticipated Prof. Sayce, not only in perceiving a relation between monuments (now recognized as Hittite) in different places in Asia Minor, but even in recognizing that certain characters on the seal were the same, or of the same kind, with those found on the Karabel monument, yet he did not perceive that these characters formed a Hamathite or Hittite inscription. It would have been scarcely possible for him to do this at the time; and this fact furnishes, in accordance with what has been said, one of the strongest arguments for the genuineness of the inscriptions on the seal. It was reserved for Prof. Sayce to detect that the seal presented a true bilingual, Assyrian and Hittite (*Academy*, August 21, 1880).

Although, as already stated, the Assyrian characters have peculiarities which distinguish them from any type of cuneiform writing otherwise known, nevertheless, with the exception of one important character, there is a tolerable agreement as to the way in which the Assyrian inscription is to be transcribed and read. If we begin with the first character after the vacant space over the king's head, this inscription, it seems to me, may be read thus:—

-me-e ▌ *Tar-ku-u-tim-me sar mat Zu-*

But if we begin, as we certainly ought to do, with the vertical wedge standing before the king's name, and denoting that the name of a man follows—represented here by a vertical black line—we have:

▌ *Tar-ku-u-tim-me sar mat Zu-me-e.*
"Tarkutimme king of the country of Zume."

The precise pronunciation of the second dental in the royal name it is impossible to determine with certainty. Some might prefer to read "Tarkudimme." But this is not of very much consequence. The difficulty to which I have adverted relates to the first character in the name of the country—the character immediately before the vacant space over the king's head. Prof. Sayce reads this as *er*, and gives as the name of the country *Er-me-e*, "Erme." To me the probability has seemed that the character should be read *su* or *zu*, the alternative reading which had been suggested by Dr. Mordtmann.[1] Certainly, with the reading *su* or *zu*, a symmetrical rendering of the Hittite inscription can be given, but with *er* this seems scarcely possible.

On comparing the spaces on the one and the other side of the figure of the king—for certainly this figure must be intended as a portrait of King Tarkutimme—it will be seen that the characters are repeated, though apparently with some variations in size and in the order of sequence. But these variations may be accounted for, if the exigencies of the space at the engraver's disposal are considered. On the left side of the king there is the greater space, and a division is effected by the king's arm and staff or spear. Consequently, in decipherment, the order observed on this side would seem to furnish the more satisfactory guidance. We may reasonably begin at the top, with the two characters above the king's arm; and these, it can scarcely be doubtful, represent the royal name Tarkutimme, inclosed and shut off as they are from the rest. How the name is to be divided between the two characters may seem not quite clear. Does the upper one denote *Tarku* and the lower *timme*, or should we divide *Tar-kutimme?* There are grounds on which the latter view seems the more probable. The Hittite hieroglyphics may possibly have been used by non-Semitic peoples, but at present the balance of evidence seems to be in favour of a Semitism more or less pure. On the Semitic hypothesis, and with the unequal division last given, both elements of the name admit of tolerably easy explanation. The first character seems certainly to be the head of a goat. There is little difficulty, in accordance with well-known vocal changes, including the substitution in Aramaic of *t* for *s*, in understanding how *tar* may represent the Hebrew *se'ar*, *sa'ir;*[2] and the second character likewise may be reasonably explained.[3] Beneath the arm is a tall cone which must certainly represent "king." This may be argued from the character being placed close to the king on both sides, as well as from its position on his left side immediately under the characters representing the royal name. It may here be observed that there was at Aleppo a Hittite inscription which unfortunately has been destroyed, and which, though it had evidently suffered from the weather and time, was in several respects of great interest. From drawings which were made from it, especially by the late George Smith, we are able, however, to form a good estimate of its evidence with regard to the king-symbol. It presented a figure—no doubt of the person celebrated in the inscription—with a symbol similarly formed and similarly marked to that in the Tarkutimme seal.

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[1] "Les mêmes caractères verticaux entre la tête et la lance que nous voyons figurés sur le sceau près de la main qui tient la lance et de l'autre côté près du grand obélisque." If anything more was intended than *characters of the same kind*, there seems to be a mistake.

[1] This conclusion was arrived at when, in 1880, my attention was first directed to the seal; and I then consulted three well-known Assyriologists. One of these was Dr. Strassmaier, who still adheres to the opinion then expressed. The very large number of texts which he has examined in the interval, while preparing his laborious and comprehensive contributions to Delitzsch and Haupt's Assyriological Library, gives his opinion the greater weight. He bases his opinion on the convergence of the two smaller wedges towards the larger horizontal wedge: strict parallelism would have been required to give the value *er*. Dr. Haupt, now Professor of Semitic Languages at the Johns Hopkins University, gave, if I recollect rightly, the value *su* rather than *zu*. Mr. S. A. Smith, who is editing and translating the Assurbanipal texts, also gives his opinion in favour of *su*.

[2] We ought also to remember in this connection that Tarsus was the chief city of Cilicia. According to the oldest authority which we have for the name (the black obelisk of Shalmaneser), the city was called *Tar-zi*. That this city should be called after the goat can scarcely seem unlikely, if we recollect how famous Cilicia was for its goats with thick and long hair, out of which Cilician cloth was made—a cloth of which, according to some, St. Paul was a weaver.

[3] In his contribution to the "Münzstudien," Dr. Mordtmann spoke of this character as "un objet difficile à reconnaître, mais qui ressemble au *pudendum muliebre*." And afterwards, in the *Z.D.M.G.*, he used similar language: "ein schwer zu bestimmendes Symbol, vermuthlich ein pudendum muliebre." Supposing this to be the object intended, there is no difficulty in understanding its bearing in a Semitic dialect the name *kutimme*. First, there is the Assyrian *katamu*, with the Arabic *katama*, "to conceal," connected with which the word would have a sense nearly equivalent to *pudendum*. But, having regard to what has been said on *tar*, it may seem that we ought to look to the Aramæan; and here we have *ketham*, "signavit," with a derivative, "*kuthema*," nearly identical in form with *kutimme*. In Gal. vi. 17 (Pesh.), *kuthema* is used in the plural of the στίγματα, which the apostle says he bore in his body. The transition from this sense is not difficult. Dr. Mordtmann's is the only probable explanation of the symbol. Special and local causes may account for its forming part even of a king's name.

The question here presents itself: In what order are the characters outside the staff or spear to be taken? Now in the Hittite inscriptions the *boustrophedon* manner of writing is observed. A line having been written from left to right, in the next the direction is reversed, and the writing goes back from right to left. This fact could not have been known to a forger in 1860, yet it is in accordance with this principle that our inscription is engraved. Having therefore read from top to bottom, we must go back, and read from the bottom towards the top. Accordingly we shall have to take next after the tall cone denoting "king" the smaller double cone. Prof. Sayce (apparently under the influence of Dr. Mordtmann's idea that the "deux petits obélisques réunis" owe their origin to the remarkable conformation of a certain district of Asia Minor) regards the double cone as denoting "country." But Dr. Mordtmann grouped these and the taller cone together, regarding all as of similar import. And, so far as their being of similar import is concerned, the conclusion seems to me inevitable. If, however, the taller cone denotes "king," the smaller cones, being of similar import, must denote "men." The tallness of the single cone is in accordance with the well-known ancient practice of denoting the greatness of a king by the greatly increased size of the figure representing him. It is true that, in accordance with Assyrian custom, the cuneiform legend gives "country." But whether a monarch is called king of a country or of the people inhabiting that country depends on local usage. "Queen of Great Britain" and "King of the French" are familiar contiguous examples in recent times. We may regard, then, the double cone as denoting "people," plurality being expressed by doubling the cone, and intensified probably by the numerous transverse marks.[1]

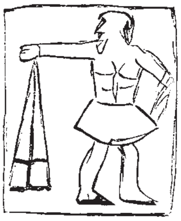

FIG. E.—"King"-symbol on Aleppo inscription.

The symbol next above the double cone is, I believe, unique, no other example being found, so far as I am aware, on any of the inscriptions. To me it seems clear that this symbol is an ideograph of the country *Zume*. There are, it will be seen, on the lower side of the lower limb three projections, which may be reasonably regarded as representing mountains. The number *three* probably denotes a good many mountains. We may take it that Zume lay along the banks of a river or estuary with mountains on one side. A remarkable analogy is presented by one of the monuments in the British Museum from Jerablûs. We have here again the oval ideograph of "city,"[2] already mentioned in connection with the Boghaz-Keui bas-reliefs. Here again, as on the Tarkutimme seal, we have the three mountains, occurring in this case on both sides. The intention is, to indicate a city located in, or at the head of, a valley lying between mountains.[1] The name of the city is in all probability denoted by the other characters, to the reader's left, the doubled curve (the doubling denoting plurality) and what is probably intended for a tree beneath.[2] This twofold indication of the name, for the sake of clearness, is entirely in accordance with the usage of both the Assyrian and Egyptian monuments. And similar evidence might be adduced from more remote sources.

Thus a twofold indication of the name Zume in the Hittite inscription on the seal must be regarded as altogether probable; and it seems to me beyond reasonable doubt that the last characters, the four nearly vertical strokes, with one horizontal, express the name Zume phonetically. Dr. Mordtmann observed, with reference to these strokes, that it would be difficult to give them a phonetic value without regarding them as numerals, but that so to regard them would be fruitless in result. In this last remark he was, I think, in error. They are, in my judgment, numerals, though here used, not with reference to their numerical value, but merely as phonetic signs; and to show that they are to be so taken, the engraver has placed them at an angle, or, so to speak, tilted them up. The last character, the two vertical strokes with one horizontal, gives precisely the Assyrian symbol for 100, but written after the archaic manner, before the wedge-writing was introduced. *Me*, the Assyrian for "a hundred," is, moreover, precisely the value that we require here. *Zu* or *su* will then be the name for 2, the first character. There is no great difficulty in connecting this with the Assyrian *sanu* 2, or *sunnu* ½, supposing that the *n* was slurred over in pronunciation and eventually dropped. And it must be remembered that, if those who made this seal spoke a Semitic dialect, there is no reason to suppose that this dialect was absolutely identical with any of the Semitic dialects otherwise known to us.[3]

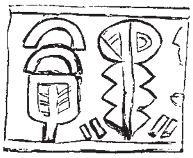

FIG. F.—Symbols from Jerablûs monument in the British Museum.

It will be thus, I think, seen that there is a reasonable correspondence between this Hittite inscription and the cuneiform inscription round the circumference of the seal. It should be observed, too, that both with regard to the king and the country the phonetic designation is supplementary—in the first case to the portrait of the king, and in the second to the ideograph of the country. The inscription is mainly ideographic. It is important that this fact should be kept in view in the decipherment of other inscriptions.

With regard to the characters behind the king, or on his right side, it should be observed not only that the engraver had on this side a smaller space at his disposal, but also that he probably thought it necessary or desirable to place close to the figure the tall cone denoting "king."

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[1] I have no hesitation in referring these cones to a phallic origin. This in early times would be regarded as a very natural way of representing "man"; and, like other designations of men, cones might easily come to denote both sexes, and a people generally.

[2] The ideograph is slightly broken on the monument.

[1] Dr. E. B. Tylor observes, "Map-making is a branch of picture-writing with which the savage is quite familiar, and he is often more skilful in it than the majority of civilized men" ("Early History of Mankind," p. 89). But of course the authors of these monuments were by no means savages.

[2] Having regard to the position of Jerablûs, where the monument was found, and to some other facts in relation thereto, I read the name conjecturally *Bamoth-elah*—that is, "Bamoth of the Terebinth."

[3] The two strokes similarly tilted up, and repeated, occur on the monument in the British Museum mentioned just above (see Fig. F). With the same value as on the seal we should have *Su-su*, or *Zu-zu*, a reading by no means improbable; but I cannot in this place discuss the matter further. Cf. Zuzim, Gen. xiv. 5, and Zamzummim, Deut. ii. 20.

That the two signs for the royal name are not engraved immediately above the cone may have resulted from the space above the king's right arm being too contracted. There is another change in the characters on the king's right side which is noteworthy. It will be seen that both the ideograph of the country and the numerals giving the name are inverted. On the left side of the king the characters were to be read from left to right of the reader, but on the right side they are to be read from right to left. This change is in accordance with the *boustrophedon* manner of writing previously mentioned, but it is a change which seems totally incompatible with the idea of forgery.

(*To be continued.*)

ELEMENTS AND META-ELEMENTS.

THE President of the Chemical Society, in his address at the anniversary meeting, has further developed views which he had already propounded in his address to Section B of the British Association at Birmingham, and in a subsequent Friday evening lecture at the Royal Institution. He would have us believe that the atoms of an element are not all precisely of one absolute pattern; that atomic weights, in fact, are not constants, as generally supposed; but that we must regard each element as a species of which many varieties exist almost infinitely more like unto each other than to the atoms of any other approximating species of element; and that what we term the atomic weight is but a mean value around which the actual weights of the individual atoms of the species range within certain limits. Could we separate atom from atom, we should find them varying in weight within very narrow limits on each side of the mean.

Mr. Crookes supports his arguments by a wealth of illustration culled chiefly from his own unique experience; and, whatever the ultimate intrinsic value to science of his hypothesis, there cannot be a question that the study of the transcendent problem of the nature of the elements will have gained greatly in fascination by its promulgation; that lines on which such study may be carried on will have been indicated; and that he will have lightened the inexpressibly wearisome labours of fractionation by casting around them the poetic play of fancy. The subject is of such importance that it appears desirable to consider the position which chemists may fairly take up, and from which it is permissible to criticize the arguments that have led to the suggestion of the existence of meta-elements.

Apart from the higher interest which Mr. Crookes has now infused into them, his researches on the rare earths will ever excite admiration in all who study them, as models of scientific investigation; and they will afford undying testimony to his determination and patience in search of truth, as well as to the incomparable fertility of resource in experimenting of which he is possessed. Among the individual observations are many of a most suggestive and striking character which, sooner or later, must claim attention; but it cannot be denied that the data are as yet insufficient for their exact interpretation. This is true also of Krüss and Nilson's remarkable observations; indeed, it may be questioned whether their results all admit of the absolute interpretation which they are inclined to put upon them. In the paper in which the omnipresence of samarium is demonstrated, in giving an account of the many anomalies which he encountered in his search for x—the substance characterized by an orange-coloured band in the phosphorescent spectrum, and which subsequently turned out to be samarium—Mr. Crookes tells us how he came to the conclusion that samaria (x), which of itself gave little or no phosphorescent spectrum in the radiant-matter tube, became immediately endowed with this property by admixture with certain other substances—lime, for example—which substances likewise of themselves had no power of phosphorescing with a discontinuous spectrum. Many substances were found effective; and there was a general resemblance between the spectra, but nearly all of them differed from one another in detail. Mixtures of samaria and yttria gave spectra differing to a very marked extent according to the proportions in which the two substances were present. All who take note of these observations must agree that they are of a most remarkable and significant character: they certainly leave no room for doubt as to the necessity of exercising the utmost caution in inferring the absence or presence of particular substances from spectral appearances and changes. Judging from Mr. Crookes's observations, and from our general knowledge of the rare earths, it would almost appear that they have the power to form double oxides akin to double salts, and the effect on the spectrum produced by associating one oxide with another may be compared with the somewhat similar effect of a solvent on the spectrum of a coloured substance. The part that such double oxides perhaps play appears as yet to have been left out of consideration. It is desirable also to take into account the possible presence of double salts, and of their influence on the spectrum, before deciding as to the bearing of Krüss and Nilson's observations.

Reference is made by the President of the Chemical Society in his address to Carl Auer's investigation of didymium. Now the differences between Auer's neo- and praseodymium—the reputed constituents of didymium—are very marked; but as yet unfortunately we have no information respecting their atomic weights. This is true also of the various reputed constituents of the rare earths studied by Mr. Crookes and Krüss and Nilson. Until such information be forthcoming, the suggestion that what is commonly regarded as the atomic weight of an element is but an average value, therefore, can only serve to direct attention anew to the extreme importance of the most exact and exhaustive study of atomic weights.

What is called yttria, according to Mr. Crookes (Proc. R.S., xl. 506) is a highly complex substance capable of being separated into several simpler substances, each of which gives a phosphorescent spectrum of great simplicity, consisting for the most part of only one line. Now, supposing that the several constituent meta-elements of ordinary yttria be found when isolated to differ almost imperceptibly from each other both in chemical properties and in weight, yet the spectral differences will admittedly be very marked—as marked perhaps as are the differences between elements which exhibit very diverse chemical properties and atomic weights; and it will be illogical to deny to these meta-elements the right to rank as elements proper—as distinct species, not mere varieties.

Why, then, does Mr. Crookes think it inadmissible in the elementary examination to open the doors so wide that the number of admissions will be limited only by the number of applicants? It is because he thinks that the periodic system of classifying the elements offers an insuperable barrier to this course. Undoubtedly, if this were granted, there would be little choice left us; but can it be granted? We think not. The scheme at present accepted is after all but a very imperfect and provisional classification. The successional order of the elements in the horizontal series is indeed determined in all cases in which the atomic weight is known with a sufficient approximation to truth; and in certain cases where the properties are clearly marked it is possible to assign the true position in the order of succession to an element even when the atomic weight is very inexactly ascertained; tellurium is an example, having been placed before iodine long ere its atomic weight was ascertained to be lower and not higher than that of